

BRIDGE DESIGN

Focus:

The objectives of this lab are to design trusses and calculate the stress on the members of the structures. The program's software greatly simplifies the calculations of stresses in complex structures.

Overview:

Trusses are composed of straight members connected at their ends by hinged connections to form a stable configuration. When loads are applied to a truss only at the joints, forces are transmitted only in the direction of each of its members. That is, the members experience tension or compression forces, but not bending forces. Trusses have a high strength to weight ratio and consequently are used in many structures, from bridges, to roof supports, to space stations.

Procedure:

This lab is a virtual lab and can be found under Bridge Designer at www.jhu.edu/~virtlab/virtlab.html.

This simulation works only for statically determinate, stable trusses. A necessary (but not sufficient) criterion for a determinate, stable structure is $M + 3 = 2*N$, where M is the number of members and N is the number of nodes. The simulation will not calculate forces unless this condition is met.

In this simulation, trusses are created by attaching members to nodes (joints.) First, nodal locations are specified. Then, the nodes are linked by members to create a structure. Once the structure is established, two of the nodes must be assigned as support nodes. One must be a "fixed" node, i.e., one that can provide support in both the x- and y-directions. The other must be a "rolling" node, i.e., one that can provide support in only the y-direction. Finally, one or more nodes can be assigned to bear loads. Once these elements are specified, a click on **Calculate** will check your design. Another click will generate a complete force diagram showing compression/tension forces in each of the members and reactive forces at the support nodes.

Nodes, members, support nodes, and loads can be added or removed at any time. After each change of configuration, a click on **Calculate** will recalculate the forces. If elements are missing or the condition for a determinate, stable structure is not met, a diagnostic message will describe the problem. (Note: for display purposes, loads should not exceed 100.)